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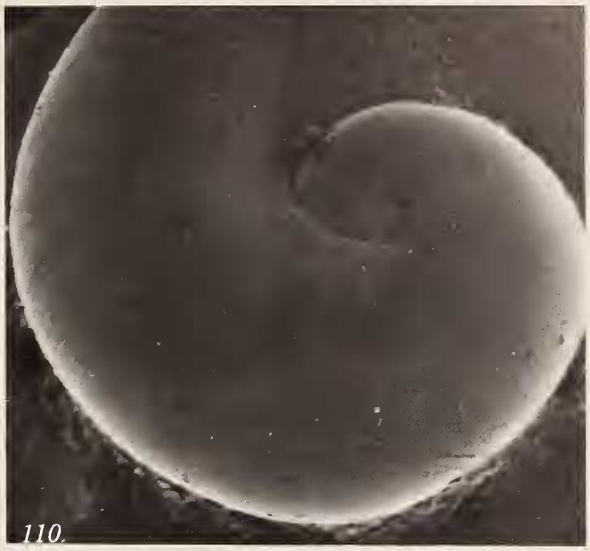
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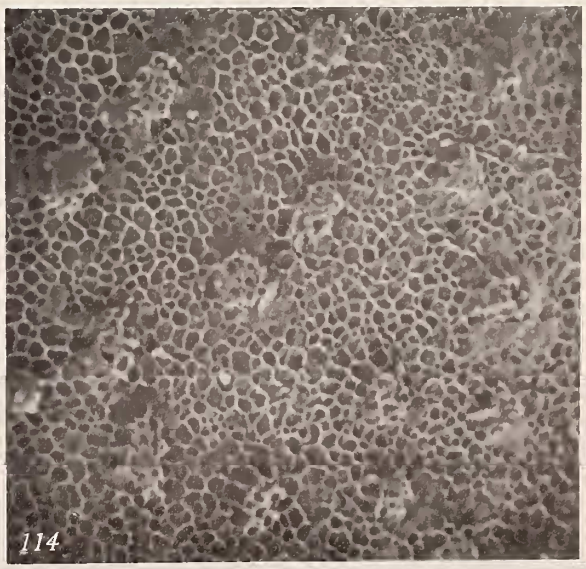
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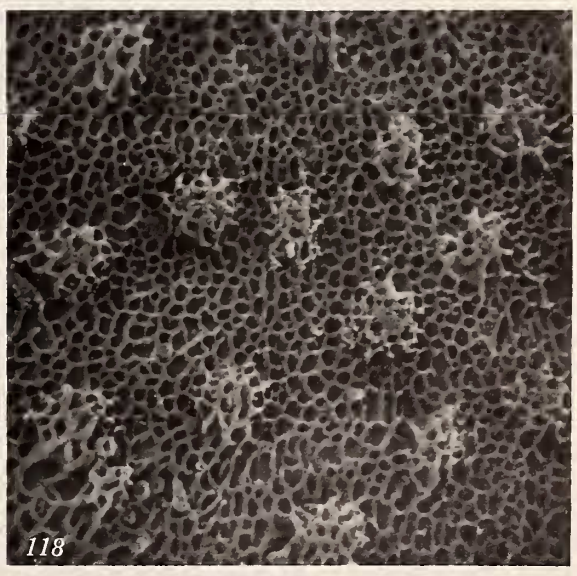
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Structures of Recent Cephalopod Radulae

BY

ALAN SOLEM

Department of Zoology, Field Museum of Natural History
Roosevelt Road at Lake Shore Drive, Chicago, Illinois 60605

AND

CLYDE F. E. ROPER

Department of Invertebrate Zoology, National Museum of Natural History
Smithsonian Institution, Washington, D. C. 20560

(4 Plates)

ATTEMPTS TO DETERMINE the possible affinities of the isolated Carboniferous nautiloid radula recently described as *Paleocadmus herdinae* Solem & Richardson, 1975 have led first to an examination of a few recent cephalopod radulae, and then, on the basis of these results, to a systematic review of radular patterns in the Cephalopoda. Scanning electron microscope (hereafter SEM) photographs from the extended survey, including observations on the pattern of variation found in sympatric congeneric species, will be published subsequently. Here we present examples from most major systematic groups, selected to show typical overall structural patterns and to indicate deduced functional differences.

SEM photographs of cephalopod radulae have been published previously by ALDRICH, BARBER & EMERSON (1971), who surveyed 22 species, covering the sepiolid *Rossia,* loliginid squids *Loligo* and *Lolliguncula,* ommastrephid squids *Illex, Todaropsis,* and *Ommastrephes,* and the octopods *Octopus, Pteroctopus,* and *Eledone.* Subsequently SOLEM & RICHARDSON (1975) illustrated the radula of *Nautilus* and discussed its function.

The species reviewed here, their systematic position and the specimens are:

CEPHALOPODA Cuvier, 1798

Coleoidea Bather, 1888

TEUTHOIDEA Naef, 1916

Myopsida Orbigny, 1845

LOLIGINIDAE Steenstrup, 1861

Loligo plei Blainville, 1823
USNM 577080, "*Geronimo*" Cruise 6, station 7-2, 26 October 1966, 18°25'N, 67°12'W, Caribbean Sea. ML (Mantle Length) =137 mm

Oegopsida Orbigny, 1839

HISTIOTEUTHIDAE Verrill, 1881

Histioteuthis dofleini (Pfeffer, 1912)
USNM 729468, *Oregon* station 6703, 21 May 1967, 16°53'N, 61°53'W, Caribbean Sea. ML=57 mm

VAMPYROMORPHA Pickford, 1939

Vampyroteuthidae Thiele, 1915

Vampyroteuthis infernalis Chun, 1903
USNM 729469, *Walther Herwig* station 482-III, 13 April 1971, 04°38'N, 19°41' W, North Atlantic Ocean, off western Africa. ML=47mm

OCTOPODA Leach, 1817

Incirrata Grimpe, 1916

Octopodidae Orbigny, 1845

Octopus briareus Robson, 1929
USNM 574777, J. Russell, 10 July 1937, 24°38'N, 82°55'W, Gulf of Mexico, Dry Tortugas. ML=39 mm

When combined with the previously published SEM illustrations of cephalopod radulae, the information presented here permits a definition of the basic strategies of radular function and an indication of patterns within the major groups of extant cephalopods.

ACKNOWLEDGMENTS

We are indebted to Anne Cohen, Michael J. Sweeney, and Barbara Walden for assistance in the extraction of buccal masses and preparing them for SEM study. The photographs illustrating this paper were made by Alan Solem on a Cambridge S4-10 scanning electron microscope provided to Field Museum of Natural History through National Science Foundation grant BMS 72-02149 A01. The enlargements were made by Fred Huysmans and mounted by Dorothy Karall. For help with manuscript preparation, we are indebted to Jayne Freshour, Barbara Walden, and Michael J. Sweeney. We thank C. C. Lu, M. J. Sweeney and R. E. Young for reading the manuscript.

METHODS

Buccal masses were prepared for SEM viewing using the technique outlined by Solem (1972). The masses were soaked in a concentrated KOH solution until the beaks could be pulled out and the muscles surrounding the radula itself were weakened enough so that the radula could be removed easily. Frequently the radula was left in KOH for an additional period, until connective tissue and muscle fibers were virtually detached. The radular membrane then was soaked briefly in alcohol and plunged into a sonic cleaner for 10 to 20 seconds in order to remove extraneous particles. Rubber cement was used to mount each radula onto an SEM stub. After drying onto the mounts, 6 stubs at a time were given first a coating of carbon and then gold in a vacuum evaporator with continuous rotation and varying tilt of the stubs during the coating processes. This insured covering of nearly all surfaces and greatly reduced the problems of charging during SEM viewing. Photographs were made on Polaroid Type 55 P/N film. The accelerating voltage ranged from 3-20 kv, depending upon the condition of individual specimens.

DESCRIPTION and FUNCTION of STRUCTURES

Traditionally the radular teeth of cephalopods have been termed rachidian, first lateral, second lateral and third lateral teeth and marginal plate (or tooth) (see Rob-

Explanation of Figures *1* to *6*

Loligo plei Blainville, 1823

USNM 577080; 18°25'N; 67°12'W; ML=137mm

Figure *1*: Part row at posterior end showing newly formed, only partly hardened teeth × 72
Figure *2*: Part row of mature teeth × 94
Figure *3*: Inner side of outer marginal teeth and inner marginal teeth × 142
Figure *4*: Detail of outer marginal teeth and marginal plates × 194
Figure *5*: Rachidian tooth showing margin of posterior basal plate and cusps × 480
Figure 6: Outer marginal teeth at artificially curved point of basal membrane to show functional relationship between marginal plates and outer marginal teeth × 136

Explanation of Figures *7* to *12*

Histioteuthis dofleini (Pfeffer, 1912)

USNM 729468; 16°53'N; 61°53'W; ML=57mm

Figure *7*: Part row in near-vertical view × 123
Figure *8*: Anterior view of part row × 200
Figure *9*: Rachidian and lateral teeth × 188
Figure *10*: Nearly vertical view of outer marginal teeth and remnants of marginal plate × 158
Figure *11*: Outer marginal teeth bent outwards, inner marginal teeth, and marginal tooth ligament (arrows) × 176
Figure *12*: Detail of marginal plate remnant × 875


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